

**ATTACHMENT**

Copy of US Provisional Application Serial Number. 60/295,060 filed June 1, 2001 entitled  
"Improved Wireless Communications Systems and Methods for a  
Communications Computer"

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES PROVISIONAL PATENT APPLICATION

for

IMPROVED WIRELESS COMMUNICATIONS SYSTEMS AND METHODS  
FOR A COMMUNICATIONS COMPUTER

Inventors:

John H. Oates  
598 Seaverns Bridge Road  
Amherst, New Hampshire 03031

Alden J. Fuchs  
160 Pine Hill Road  
Nashua, New Hampshire 03063

Jonathan E. Greene  
83n Hollenbeck Avenue  
Great Barrington, Massachusetts 01230

Frank P. Lauginiger  
772 Russell Station Road  
Francestown, New Hampshire 03043

Paul E. Cantrell  
15 Prescott Drive  
Chelmsford, Massachusetts 01863

Jan N. Dunn  
48 North Court Street, #1  
Providence, Rhode Island 02903

Steven R. Imperiali  
43 Haynes Road  
Townsend, Massachusetts 01469

Kathleen J. Jacques  
10 Juniper Street  
Jay, Maine 04239

William J. Jenkins  
61 Heritage Lane #C4  
Leominster, Massachusetts 01453

David E. Majchrzak  
11 Regine Street  
Hudson, New Hampshire 03051

Mirza Cifric  
705 Mass Avenue  
Boston, Massachusetts 02118

Michael J. Vinskus  
5 Cranberry Lane  
Litchfield, New Hampshire 03052

### **Background of the Invention**

The invention pertains to wireless communications and, more particularly, to communications computers. The invention has application, by way of non-limiting example, in improving the capacity of cellular phone base stations.

Code-division multiple access (CDMA) is used increasingly in wireless communications. It is a form of multiplexing communications, e.g., between cellular phones and base stations, based on distinct digital codes in the communication signals. This can be contrasted with other wireless protocols, such as frequency-division multiple access and time-division multiple access, in which multiplexing is based on the use of orthogonal frequency bands and orthogonal time-slots, respectively.

A limiting factor in CDMA communication and, particularly, in so-called direct sequence CDMA (DS-CDMA), is the interference between multiple simultaneous communications, e.g., multiple cellular phone users in the same geographic area using their phones at the same time. This is referred to as multiple access interference (MAI). It has effect of limiting the capacity of cellular phone base stations, since interference may exceed acceptable levels -- driving service quality below acceptable levels -- when there are too many users.

A technique known as multi-user detection (MUD) reduces multiple access interference and, as a consequence, increases base station capacity. MUD can reduce interference not only between multiple signals of like strength, but also that caused by users so close to the base station as to otherwise overpower signals from other users (the so-called near/far problem). MUD generally functions on the principle that signals from multiple simultaneous users can be jointly used to improve detection of the signal from any single user. Many forms of MUD are known; surveys are provided in Moshavi, "Multi-User Detection for DS-CDMA Systems," IEEE Communications Magazine (October, 1996) and Duel-Hallen et al, "Multiuser Detection for CDMA Systems," IEEE Personal Communications (April 1995). Though a promising solution to increasing the capacity of cellular phone base stations, MUD techniques are typically so computationally intensive as to limit practical application.

An object of this invention is to provide improved methods and apparatus for wireless communications. A related object is to provide such methods and apparatus for multi-user detection or interference cancellation in code-division multiple access communications.

A further object of the invention is to provide such methods and apparatus as can be cost-effectively implemented and as require minimal changes in existing wireless communications infrastructure.

A still further object of the invention is to provide methods and apparatus for executing multi-user detection and related algorithms in real-time.

A still further object of the invention is to provide such methods and apparatus as manage faults for high-availability.

### **Summary of the Invention**

These and other objects are met by the invention which provides, in one aspect, a communications computer, referred to as the "MCW-1" (among other terms) in the materials that follow, and methods of operation thereof. An overview of that system is provided in the section entitled "Communications Computer," beginning on page 5 hereof. A more complete understanding of its implementation may be attained by reference to the other attached materials.

In view of those materials, aspects of the invention include, but are not limited to the following:

- architecture and operation of a communications computer for a wireless communications system, including a fully programmable computer inserted into base transceiver station (BTS) to support compute-intensive and/or highly data-dependent functions such as adaptive processing and interference cancellation

These and other aspects of the invention (including utilization of the aforementioned methods and aspects for other than wireless communications and/or interference cancellation) are evident in the materials that follow.

**Detailed Description of the Invention**

See the attached materials on pages 5 – 11 hereof, providing description and block diagram of a preferred structure and operation of a communications computer for wireless applications according to the invention.

The aforementioned materials pertain to improvements on the methods and apparatus described in United States Provisional Application Serial No. 60/275,846, filed March 14, 2001, entitled IMPROVED WIRELESS COMMUNICATIONS SYSTEMS AND METHODS and United States Provisional Application Serial No. 60/289,600, filed May 7, 2001, entitled IMPROVED WIRELESS COMMUNICATIONS SYSTEMS AND METHODS USING LONG-CODE MULTI-USER DETECTION, the teachings of both of which are incorporated herein by reference and copies of at least portions of which are attached hereto. Those copies bears the U.S. Postal Service Express Mail label number of both prior filings, as well as that of this filing (the latter being referred to as the "New Exp. Mail Label No.").



## *Communications Computer*

- Fully programmable computer inserted into base transceiver station (BTS) to support compute-intensive and/or highly data-dependent functions such as adaptive processing and interference cancellation
  - Overcomes rigidity of ASIC-based application implementation
  - Overcomes limitations of DSP instruction sets
  - Overcomes traditional inter-processor bandwidth limitations
    - By using modern processor interconnect technology rather than busses
  - Enables remote modification of functionality by software download
- High-profile applications:
  - Multi-user detection (MUD)
  - Interference cancellation
  - Smart and adaptive antenna processing
  - Interference avoidance

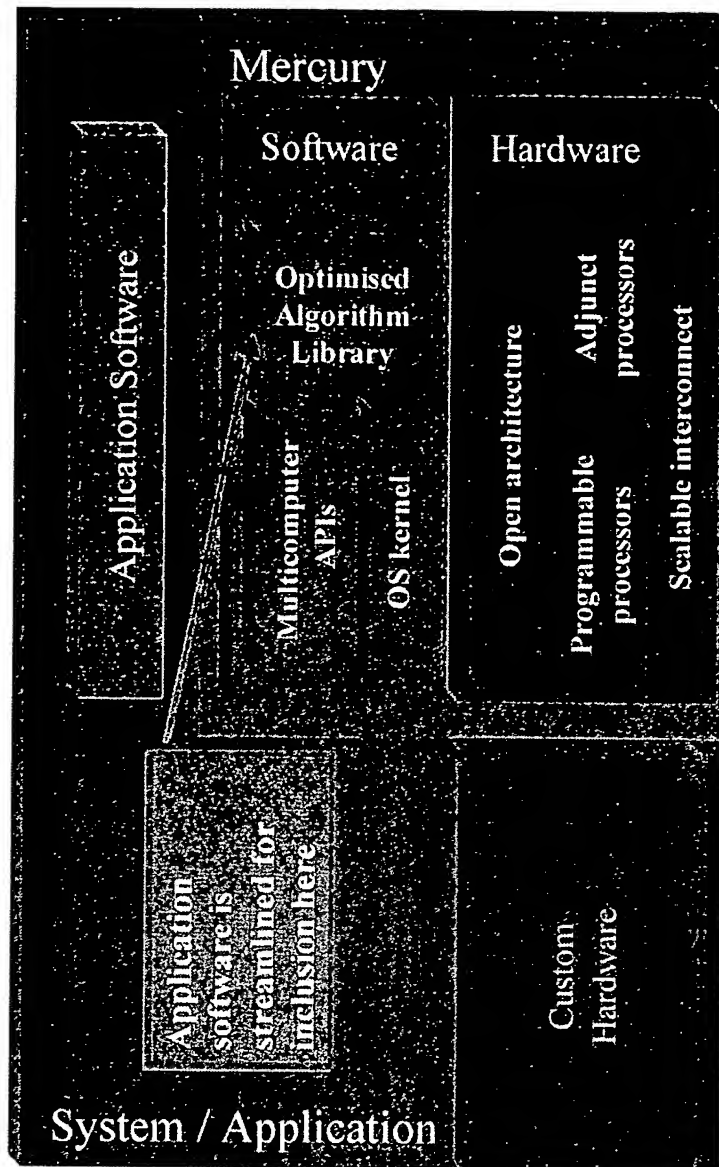


## *Communications Computer (Cont.)*

- Multiple communications computers can be interconnected to promote
  - Load balancing among cell site sectors
  - Improved fault resilience
  - Additional algorithm sophistication/complexity
  - Functionality of additional algorithms
- Communications computer concept can be extended by interconnection to encompass full BTS functionality



## *Mercury Generic Model*

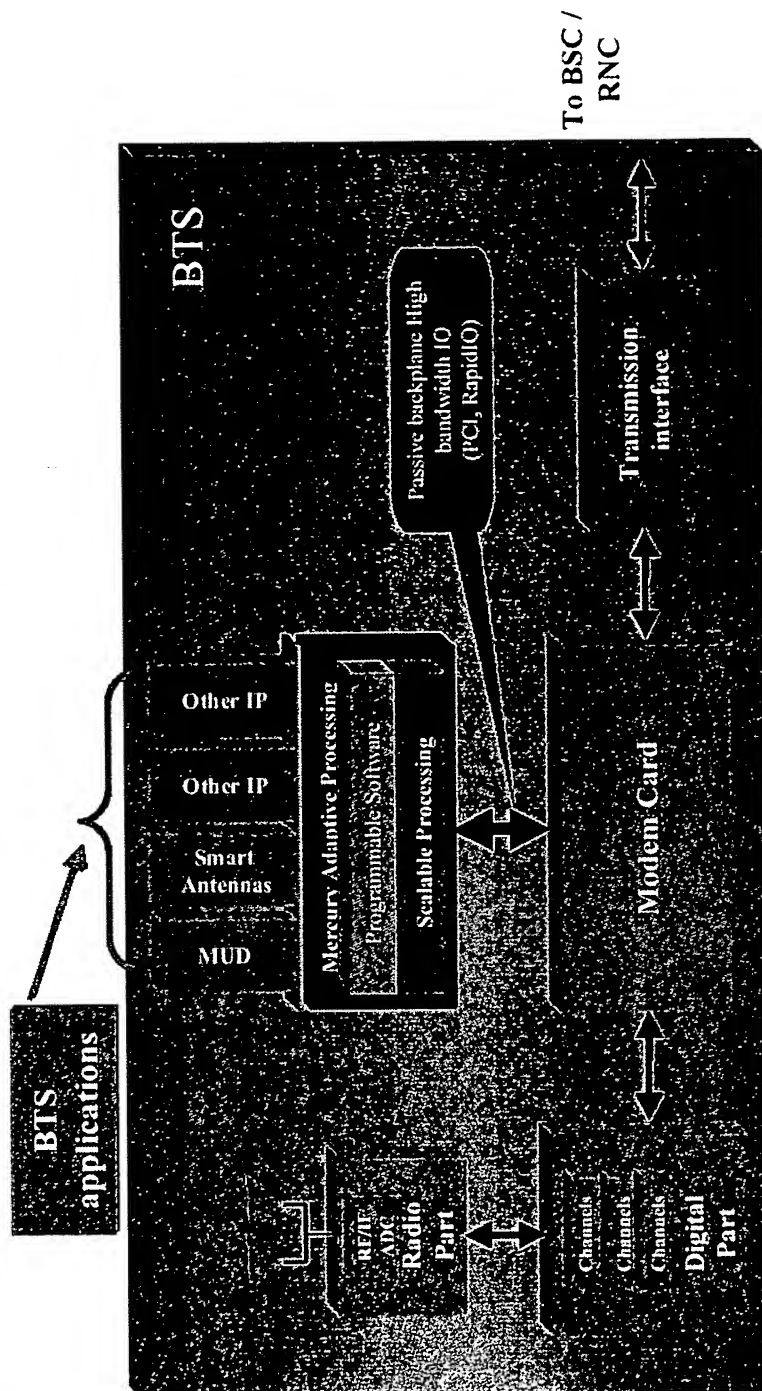


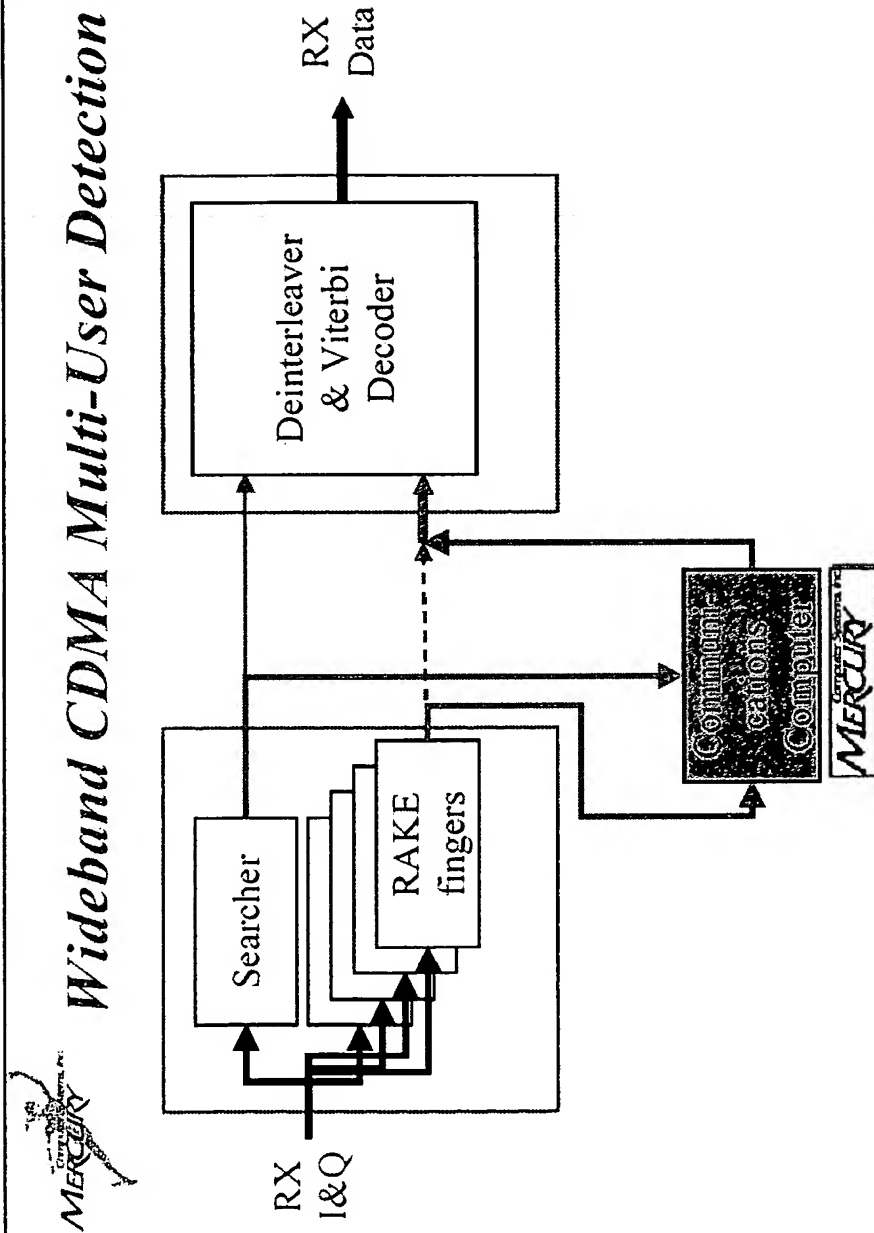
Open  
interface  
standards





# Communications Computer Concept

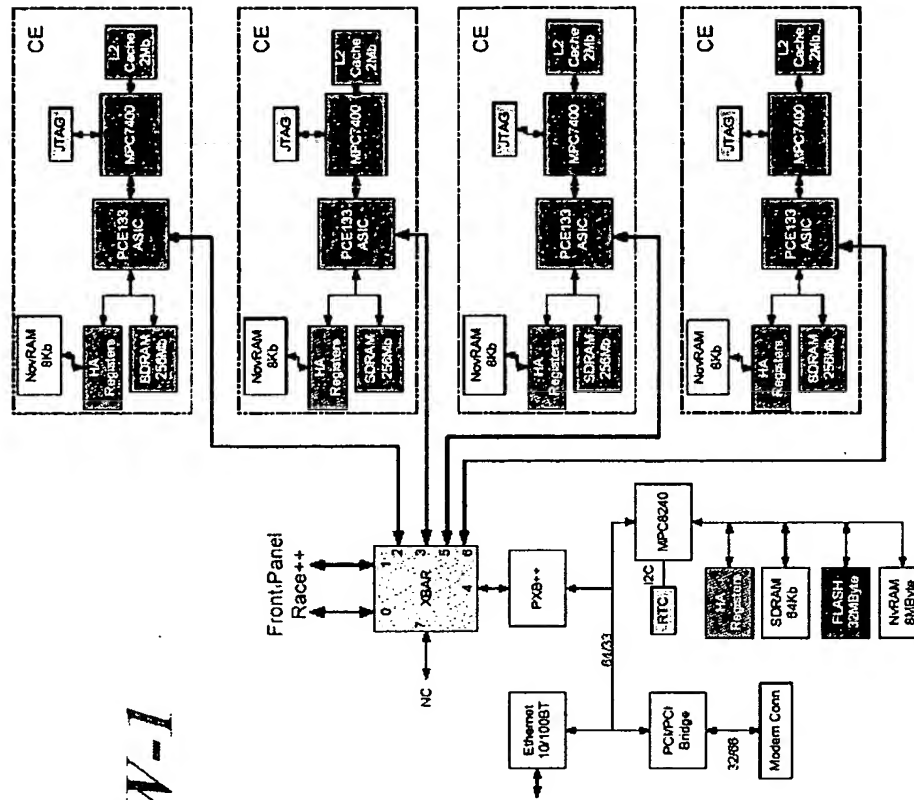






## *Communications Computer Prototype: MCW-1*

- Interconnectable telco-grade multicomputer boards and system software suitable for MUD, interference cancellation, and other adaptive processing applications
  - Hardware: Four G4/Nitros and SDRAM; plus MPC8240, watchdogs, NVRAM, PCI and Enet connectivity...
  - Scalable up and down in complexity
  - Software: Application; autonomous fault monitoring, detection, isolation, recovery; automatic remote software update; remote access via embedded web server



MCW-1